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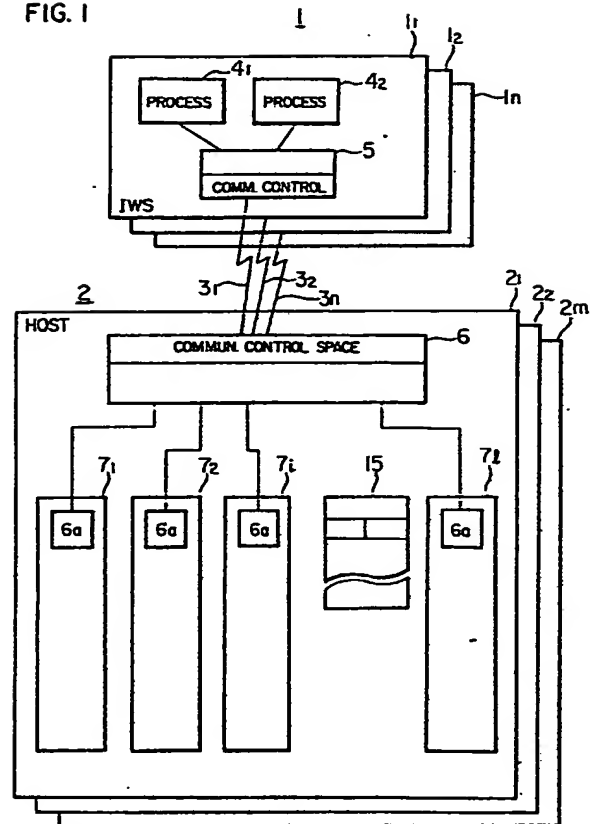
(54) Distributed interactive processing method in complex system including plural work stations and plural host computers and apparatus using the same.

(57) A distributed interactive processing in a complex computer system including a plurality of work stations (IWS's) (1<sub>1</sub>, 1<sub>2</sub> ..., 1<sub>n</sub>) each having predetermined server processes, at least one host computer (HOST) (2<sub>1</sub>, 2<sub>2</sub> ..., 2<sub>m</sub>), communication lines (3<sub>1</sub>, 3<sub>2</sub> ...) interconnecting between the plurality of IWS's and the HOSTs, and communication control portions (5, 6) to establish and to control communication paths (3<sub>1</sub>, 3<sub>2</sub> ...) between processes (4, 7) to conduct a process-to-process communication between the IWS's (1<sub>1</sub>, 1<sub>2</sub> ..., 1<sub>n</sub>) and the HOSTs (2<sub>1</sub>, 2<sub>2</sub> ..., 2<sub>m</sub>). Each IWS has therein a process (4<sub>1</sub>, 4<sub>2</sub> ... 4<sub>i</sub>) to implement an assigned processing request and a request control section (11) to analyze the processing request issued by the own IWS (1<sub>1</sub>, 1<sub>2</sub> ..., 1<sub>n</sub>) and to determine a server process (7<sub>1</sub>, 7<sub>2</sub> ..., 7<sub>1</sub>) required to implement the processing request. Among a result of the request analysis, a predetermined server

process is executed in the own IWS. The communication control portions (5, 6) establish a communication path (3<sub>1</sub>, 3<sub>2</sub> ...) between an associated server process (7<sub>1</sub>) in the relevant HOST (2<sub>1</sub>, 2<sub>2</sub> ..., 2<sub>m</sub>) and the request process (4) in the IWS in accordance with the determination in the IWS regarding server process and thereby enable the IWS (1<sub>1</sub>, 1<sub>2</sub> ..., 1<sub>n</sub>) to perform an on-line interactive processing in combination of the server process (7<sub>1</sub>) in the HOST (2<sub>1</sub>, 2<sub>2</sub> ..., 2<sub>m</sub>) and the process (4) in the IWS (1<sub>1</sub>, 1<sub>2</sub> ..., 1<sub>n</sub>).

EP 0 248 403 A2

FIG. 1



## DISTRIBUTED INTERACTIVE PROCESSING METHOD IN COMPLEX SYSTEM INCLUDING PLURAL WORK STATIONS AND PLURAL HOST COMPUTERS AND APPARATUS USING THE SAME

### BACKGROUND OF THE INVENTION

The present invention relates to a complex system including intelligent work stations and host computers (to be simply referred to as "hosts" herebelow) connected by a micro main frame connection therebetween, and in particular, to a distributed interactive processing method suitable to distribute the load on the hosts to the intelligent work stations (referred to as "IWS's" herebelow).

In an interactive processing system such as the time sharing system (TSS), for the user's request issued from a terminal equipment, the syntactical check has been effected on the terminal side as described in the JP-A-60-144839. However, the request itself is analyzed in the virtual address space of a host computer to select a program satisfying the request in the same space. The selected program first arranges the necessary environment, for example, allocates file and effects an OPEN processing thereon, and then executes the requested processing.

Although the TSS is suitable for an irregular job including various kinds of data, the processing is attended with a large overhead and the number of terminals to be simultaneously supported is limited. The TSS of this kind has been well known. For example, refer to Watson, R.W. "TSS Design Concepts" McGraw Hill Computer Science Series McGraw-Hill Book Co. NY. 1970.

In the transaction processing system (on-line system), a request is issued from a terminal in a small unit called a transaction to a host computer. A transaction executes a processing in accordance with the request in a fixed fashion in a space where the pertinent environment is arranged in advance.

In the transaction processing system, the processing is effected in the unit of transaction, namely, in an intermittent manner and in a fixed fashion. Consequently, this system is suitable for use with an automatic banking machine and the like of a bank; however, the transaction processing system is not suitable for an irregular job including various kinds of unfixed data.

In other words, as shown in Fig. 8, regular job requests supplied from a great number of terminals, for example, several thousands in number are processed in a fixed fashion. The host is provided with a data communication program to be effected by a terminal control section and job programs each for achieving a regular or fixed job and an input from a terminal is processed by a job program structured for a fixed purpose.

In the TSS, as shown in Fig. 9, request indications inputted from a relatively small number of terminals i.e. about 100 in number are received in a logical space disposed for each terminal and is subjected to a request analysis, and then a processing program is loaded for execution. In the host, there are provided a terminal control program, a request analysis program to analyze requests from the respective terminals, and processing programs corresponding to the respective requests. Since the request analysis program and the processing programs are prepared for each terminal, the TSS is suitable for an irregular job handling various kinds of data.

In the TSS and the transaction processing system, a terminal is assigned to a host computer and cannot be easily allocated to be commonly or randomly shared among a plurality of host systems.

In the TSS of the conventional technology, although the syntactical check may be considered to be achieved in a terminal equipment, the request analysis cannot be implemented therein; consequently, there is provided a process (virtual address space) for each terminal to execute programs therein, namely, the request from a terminal is analyzed in the space and the processing environment is established in the same space, thereby executing a processing associated with the request. As a result, although the TSS is suitable for the irregular job to process various kinds of unfixed data, a large load is imposed on the host, which therefore cannot simultaneously process the requests from many terminals.

Furthermore, in the transaction processing system, there does not exist a connection between a terminal and a particular process (space) of the host computer, namely, there is not allocated a processing space dedicated to each terminal, and a routine or regular processing is effected in an intermittent fashion. Consequently, the load on the host can be reduced; however, irregular requests cannot be freely processed in the transaction processing system.

Moreover, in a system including a plurality of host computers, a terminal is required to be connected to a particular host before starting an interactive processing, which leads to a problem that terminals cannot concurrently and arbitrarily access a plurality of hosts for the services thereof.

## SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a distributed interactive processing method and an apparatus using the same in a complex computer system suitable for an irregular job handling various kinds of unfixed data and capable to minimizing a load on the hosts by distributing the load to intelligent terminals.

The object can be accomplished by a method in which a plurality of server processes (virtual address spaces) are provided in the host corresponding to the respective requested and based on a result of an analysis conducted on a processing request in an intelligent terminal, the processing request for other than the intelligent terminal is transmitted to a particular server of a particular host corresponding to the processing request, thereby enabling the server to execute the processing.

A user's request issued in an intelligent terminal is analyzed in the work station. When the work station recognizes that a particular server process in a particular host is necessary, a connection to the particular objective server process is established by means of a communication between processes. The server process sequentially receives processing requests from the process of the work station thus connected. Since the server process is a process prepared to realize or implement a predetermined kind of request, the processing can be effected without re-establishing the processing environment for each request. Thus, since one server process can receive processing requests from a plurality of terminals the host can assign an address space smaller than the number of the terminals thereby to reduce the address space of hosts.

When the kind of request from the user is changed, a new connection to another server process is established via the IWS and the processing is continued. In this situation, since the communication between processes (program executions) can be achieved with respect to any host, the server process may exist in an arbitrary host, and hence, in the case of a system including a plurality of hosts, the IWS can sequentially issue a request to the server process of each host to interactively perform an operation from the IWS.

## BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

Fig. 1 is an overall system configuration diagram of a complex computer system including intelligent terminals and host computers according to the present invention;

Fig. 2 is a schematic block diagram illustrating the operation on the intelligent work station (IWS) side;

Fig. 3 is a schematic block diagram illustrating the operation on the host side;

Figs. 4 to 6 are flow charts respectively for explaining the operations of the screen control section, the request analysis/status control section, and process section of Fig. 2;

Fig. 7 is a block diagram exemplarily illustrating the configuration of the host;

Figs. 8 and 9 are explanatory diagrams for explaining the prior art TSS and on-line system, respectively; and

Fig. 10 is a conceptual diagram of the present invention useful for the comparison with the systems of Figs. 8 and 9.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

A description will be given of an embodiment of the present invention with reference to the accompanying drawings.

In Fig. 1 there is shown an overall configuration of a distributed interactive processing system which comprises an intelligent work station side 1 and a host computer side 2 connected to each other according to the present invention. Intelligent work stations (IWS's)  $1_1, 1_2, \dots, 1_n$  in the side 1 are connected to host computers  $2_1, 2_2, \dots, 2_m$  in the side 2 via communication lines  $3_i (i = 1, 2, \dots, 1)$ . Each IWS  $1_i$  includes a plurality of processes  $4_i$  each for processing the user's request and a communication control section 5 for controlling communication lines  $3_i$ . Each host computer comprises a host supervisor (program) providing a communication control space 6 for controlling the communication lines  $3_1, 3_2, \dots$  and a plurality of servers  $7_1, 7_2, \dots, 7_l$  for executing processing associated with the processing requests. The servers  $7_1, 7_2, \dots$  are classified in accordance with the kinds associated with the processing requests from the process  $4_i$  in the IWS  $1_i$ , and a particular request from the process  $4_i$  is executed by a particular server  $7_i$  corresponding thereto.

Next, referring to Fig. 2 and subsequent diagrams, the operation of the present invention will be described.

Fig. 2 is a block diagram schematically illustrating processing blocks in the IWS  $1_i$  by way of example for IWS. The IWS  $1_i$  is connected to a display 8 and a mouse 9 as an input device for

specifying a position on the display 8. The end user at the IWS 1<sub>i</sub> selects by means of the mouse 9 a graphic image called "Icon" displayed on the display device 8 in order to issue a request. The Icon is displayed as a graphic image associated with a name assigned to a resource such as a file, a program, or the like in a meaningful manner, thereby helping the user easily identify the resource. For example, a graphic image or picture illustrating a combination of a report sheet and a table is used as an Icon to represent a file storing data in a table format. The user identifies Icons representing objective files and programs for a desired operation among the Icons displayed on the screen of the IWS 1<sub>i</sub> and operates the mouse 7 to move the arrowmark cursor to the pertinent Icon on the screen, thereby effecting an operation to select the Icon.

When the user selects one of Icons displayed on the screen by the screen control section 10 (step 41 of Fig. 4), the position select signal is inputted from the mouse 9 to the screen control section 10 of the IWS 1<sub>i</sub>, and then the Icon number is obtained through the steps 42-47 of Fig. 4. The request analyze/status control section 11 receives the Icon number and the operation request. As shown in the steps 51-53 of Fig. 5, the request analyze/status control section 11 checks to determine a location where a processing for the selected Icon is to be effected or can be achieved, namely, based on the Icon number, an Icon attribute table 12 stored and developed in the storage of the IWS 1<sub>i</sub> in advance is searched for a process name corresponding to the relevant Icon. To the Icon attribute table 12, there have been registered entries each including a pair of a kind of Icon 12a and a name of process 12b to implement processings for the Icon. Consequently, the name of the process to execute the processing can be determined by effecting a retrieval through the Icon attribute table 12. The request analyze/status control section 11 initiates a process 4<sub>i</sub> having the name thus determined (step 53).

The initiated process 4<sub>i</sub> obtains names of the processing objectives such as a file name and a program name extracted from the Icon attribute table 12. Since the processing objectives are entirely registered to a directory 13 in the IWS 1<sub>i</sub> in advance, the locations thereof are determined by conducting a retrieval through the directory 13. The name of a processing objective comprises a name in which node names of the directory 13 are linked to each other, and hence the nodes of the relevant directory 13 can be directly traced by use of the name of the processing objective. As described above, the directory 13 is configured in a tree structure. Namely, in an upper node 13a of a node 13b of the determined objective, there is stored an

existence location (indicating an existence processor name of a processor where the node 13b exists, or a destination processor name (host name) for other than the own processor). Consequently, the process 4<sub>i</sub> can determine the destination or mate processor based on the name of the processing objective. The operation flow of the process 4<sub>i</sub> is shown in the steps 61-67 of Fig. 6. Here, if the existence locations of the processing objectives are in the own IWS 1<sub>i</sub>, the processing request can be accomplished in the IWS 1<sub>i</sub>. If the existence locations are in another processor i.e. host, the directory 13 is searched to determine the name of the server 7<sub>i</sub> in a host corresponding to the process 4<sub>i</sub> in the IWS 1<sub>i</sub>. It is here assumed that the name of the server 7<sub>i</sub> is stored in the storage within the IWS 1<sub>i</sub> corresponding to the processing requested by the process 4<sub>i</sub>. When the host name and the name of the server 7<sub>i</sub> in the host are determined, the process 4<sub>i</sub> issues a connection request to the communication control section 5 to establish a connection of IWS 1<sub>i</sub> to the objective server process 7<sub>i</sub>. Based on the previously defined information such as a protocol, the communication control section 5 connects the communication line 3<sub>i</sub> to the destination processor i.e. relevant host computer 2<sub>i</sub>. After the connection is completed, the communication control section 5 transfers a connection request buffer 14 to the host 2.

In order to establish a logical communication path between the process 4<sub>i</sub> and the server process 7<sub>i</sub> to be connected in the host 2<sub>i</sub>, the communication control section 5 of the IWS 1<sub>i</sub> generates a connection request buffer 14 providing information indicative of a logical request for connecting the name of the process 4<sub>i</sub> and the name of the destination server process 7<sub>i</sub> into a virtual memory of IWS 1<sub>i</sub>. When a logical communication path is established as a result, the process 4<sub>i</sub> in the IWS 1<sub>i</sub> can directly achieve communication with the server process 7<sub>i</sub> of the host 2<sub>i</sub>. The contents of request buffer area 14 are transferred to the communication control space 6 including a local supervisor program of the host 2<sub>i</sub> via the communication line 3<sub>i</sub> connecting the IWS 1<sub>i</sub> to the host 2<sub>i</sub>. The communication control space 6 has a function to accept a connection request and a processing request sent from the respective IWS 1<sub>i</sub> and to distribute the received requests to the corresponding ones of the server processes 7<sub>1</sub>, 7<sub>2</sub>, 7<sub>3</sub>, ....

Referring now to Fig. 3, the configuration and operation of the host 2<sub>i</sub> will be described by way of example.

The host 2<sub>i</sub> includes the communication control space 6 for receiving the connection and processing requests from the IWS 1<sub>i</sub> and for transferring the received requests to a relevant server 7<sub>i</sub>.

Information received via the communication line 3<sub>i</sub> is stored in a buffer (area) existing in a virtual storage of the communication control space 6. The information sent from the IWS 1<sub>i</sub> includes the name of the process 4<sub>i</sub> as the source and the name of the server process 7<sub>i</sub> as the destination. In addition, information indicating the content of the request is also included in the sent information. When the content of the request is to establish a logical communication path, the communication control space 6 obtains the name of the server process 7<sub>i</sub> in the host for which the communication path is to be established by use of the information received via the communication line 3<sub>i</sub>. The server process 7<sub>i</sub> is a process to implement a function on a particular operation objective contained in the request issued from the IWS 1<sub>i</sub> to the host 2<sub>i</sub>. For example, the mail server accomplishes a function in the case where the operation objective is an electronic mail, namely, conducts the retrieval, distribution, and reception of the electronic mail. Moreover, there are provided the multi-media document server to store, to retrieve, and to extract the multi-media document; the print server to edit and to print the multi-media; and the data base server to retrieve, to store, and to extract the data base. At the initiation in the host 2, the server process 7<sub>i</sub> conducts an initial report to the communication control space 6. Upon receiving the start request, the communication control space 6 registers to a process name table 15 the name of the server process 7<sub>i</sub> received through the initiation report and the identifier of the space of the server process 7<sub>i</sub>.

When a request to establish a logical communication path is received from the IWS 1<sub>i</sub>, the communication control space 6 effects a retrieval on the process name table 15 by use of the server process name in the information transmitted together with the request and obtains the space of the server process 7<sub>i</sub>. In the server process 7<sub>i</sub>, a task called the communication control section 6a is beforehand initiated at the initiation report of the server process 7<sub>i</sub> and is waiting for a report from the communication control space 6. The communication control space 6 transmits the report to the communication control section 6a in the server process 7<sub>i</sub> by means of an interspace communication function (cross-memory post). On receiving the report from the communication control space 6, the communication control section 6a receives from the communication control space 6 the data indicating the request to establish a logical communication path, the data being transferred via an area of the virtual storage to be commonly used by the respective spaces 6 and 7<sub>i</sub>. In the case where the request to open the logical communication path is to be accepted, an acknowledge answer is returned to the communication control space 6. The ac-

knowledge answer is reported by use of a cross-memory post generated in a buffer of the common virtual storage. The communication control space 6 passes the acknowledge answer via the communication line 3<sub>i</sub> to the communication control section 5 of the IWS 1<sub>i</sub>. The communication control section 5 notifies the process 4<sub>i</sub> from which the request has been issued that the logical communication path has been established.

Through the procedures above, the process 4<sub>i</sub> in the IWS 1<sub>i</sub> establishes the logical communication path to the server 7<sub>i</sub> in the objective host 2<sub>i</sub>. In this operation, the identification number of the logical communication path is transferred to the process 4<sub>i</sub> in the IWS 1<sub>i</sub> and the server 7<sub>i</sub> in the host 2<sub>i</sub>.

When the logical communication path is established, the process 4<sub>i</sub> in the IWS 1<sub>i</sub> is enabled to freely communicate with the server 7<sub>i</sub>, and then like in the TSS, the server 7<sub>i</sub> in the host 2<sub>i</sub> executes a processing for the function requested to the host 2<sub>i</sub>. To effect a particular request for the server 7<sub>i</sub>, the process 4<sub>i</sub> generates request information in the virtual storage of the IWS 1<sub>i</sub>, specifies the identification number of the logical communication path, and notifies the information to the communication control section 5. The communication control section 5 then transmits the information to the communication control space 6 in the host 2<sub>i</sub> via the communication line 3<sub>i</sub>. Based on the identifier of the logical communication path, the information is recognized to be destined to the server 7<sub>i</sub>; consequently, the information is delivered to the server 7<sub>i</sub>.

The server 7<sub>i</sub> is a server for handling a particular operation objective, for example, a mail server for the electronic mail or the multi-media document server for the multi-media document.

Since the server handles only the particular operation objective, it is possible to beforehand effect the OPEN processing by allocating the necessary files to the space of the server 7<sub>i</sub>. To this end, in the space of each server 7<sub>i</sub>, the fixed files required to handle the operation objectives of the server are subjected to the OPEN processing at the initiation. Fig. 7 shows the general configuration of the server 7<sub>i</sub>, which comprises a communication accept section 6a for receiving data from the communication space 6, a server control task 7a for conducting analysis of the content of data transferred, and a plurality of request processing tasks 7b for implementing the functions of the requests.

The server task 7a issues a connect request to the communication control space 6 at the initiation, and as a result of the request, the communication accept section 6a is generated as a task. The server control task 7a then allocates the necessary files, opens the files, and waits for a request sent from the IWS side 1.

On receiving a processing request after the logical communication path to for example, the IWS 1<sub>i</sub> is opened, the server 7<sub>i</sub> analyzes the request by use of the server control task 7a. As a result, if the pertinent request processing task 7b has already been assigned, the server 7<sub>i</sub> passes the request to the request processing task 7b; otherwise, the server 7<sub>i</sub> selects a free task 7b and assigns the request to the task 7b. The request processing task 7b effects the processing in accordance with the content of the request from the IWS 1<sub>i</sub>. The processing result is returned to the process 4<sub>i</sub> in the IWS 1<sub>i</sub> by means of the same logical communication path 3<sub>i</sub>.

As described above, the server 7<sub>i</sub> is a processing space in which the environment is arranged to meet the particular processing request (i.e. the file allocation and the OPEN processing of the files have been completed). Although each server 7<sub>i</sub> can effect a processing execution only for a particular processing request, a plurality of requests can be received, namely, the requests from many IWS's can be simultaneously processed with respect to the space by use of, for example, the technology of the time slicing.

When the user's request to operate the IWS 1<sub>i</sub> is changed and a change-over function to change over control to another server becomes necessary, the analyze/status control section 11 in the IWS 1<sub>i</sub> initiates a process corresponding to a new icon and then a connection to a new server in the host 2<sub>i</sub> is established in accordance with the IWS-host connect procedure. This connection is independent of the previous connection, namely, the previous connection may be retained to be used again when necessary. If such a connection is unnecessary, the connection is released as soon as possible. If necessary, a plurality of requests may be concurrently issued by use of two connections at the same time so as to be processed concurrently.

An example to effect the change-over of servers 7 in the IWS 1 is as follows.

An electronic mail is received (by the electronic mail server), the electronic mail is stored in an electronic cabinet (multi-media document store file) by means of the multi-media document server, and the document is printed by use of the print server.

This sequence of processing is implemented as follows. In accordance with a request issued from the IWS 1 operator, the electronic server is connected to the IWS 1, a request is issued to the electronic mail server to achieve the "electronic mail receive" function. Next, the multi-media server is connected and a request is made to the multi-media server to conduct the "store" function, and finally, the print server is connected and then a request is issued thereto to effect the "print" function.

According to the embodiment, since the user's request is analyzed in the IWS 1 and the processing environments (allocation and OPEN processing of files, development of tables in the memory, etc.) need not be set in each server of the host, and the server processes requests from a plurality of IWS's, which enables the number of server spaces to be limited, the load on the host can be reduced. Consequently, the number of IWS's to be connected to the host can be increased by the magnitude on the order of ten as compared with that of the prior art TSS.

Moreover, in some cases, the server satisfying the processing request need not be necessarily allocated to a particular host, namely, data such as documents and tables of each host can be freely and in the same procedure accessed through the server of the common kind disposed in each host.

Comparing now the method of the present invention with the prior art examples of Figs. 8 and 9, in the distributed interactive system of the present invention of Fig. 10, IWS's 1 are located on a plurality of terminal sides like in the on-line system to effect on the terminal sides the analysis of the request input from the terminal user, and on the host side, there are provided a communication program for conducting communications with the programs (processes) on the IWS 1 side and various servers each having a single function; consequently, processing requested from the plural IWS's can be collectively or concurrently be accomplished. As a result, although the regular job and the irregular job can be processed in the present system, the range of the job may be limited depending on the kinds of servers.

It will be noted that the following advantages are obtained according to the present invention.

(1) In the conventional TSS, each TSS terminal has an individual space, and hence a great number of spaces are required. As a consequence, all spaces cannot be located in the memory and the processing is therefore executed by effecting a swap-out operation. Moreover, the change-over between spaces must be quite frequently achieved, which leads to a great overhead.



According to the present method, the number of server spaces is limited and hence the overhead associated with the number of spaces is reduced.

(2) Since the operation objective of each server is clearly specified, the environments necessary to implement the particular function such as the tables and files in the memory can be kept prepared in advance.

(3) Since the request is analyzed on the IWS side and the destination server is also determined therein, the special space to effect the request analysis is not necessary for the server on the host side, namely, the individual space required in the case of the TSS becomes unnecessary.

As a result, the host can dedicatedly effect the server processing.

While the present invention has been described with reference to the particular embodiment, it is not restricted by the embodiment but only by the appended claims. It is to be appreciated that those skilled in the art can change or modify the embodiment without departing from the scope and spirit of the invention.

#### Claims

1. A distributed interactive processing method in a complex computer system including:

at least one work station (1<sub>1</sub>, 1<sub>2</sub> ..., 1<sub>n</sub>);

at least one host computer (2<sub>1</sub>, 2<sub>2</sub> ..., 2<sub>m</sub>);

communication lines (3<sub>1</sub>, 3<sub>2</sub> ...) connecting between said work station (1<sub>1</sub>, 1<sub>2</sub> ..., 1<sub>n</sub>) and said host computer (2<sub>1</sub>, 2<sub>2</sub> ..., 2<sub>m</sub>); and

control means (5, 6) for controlling communication paths between processes (4, 7) to enable communications between said work station (1<sub>1</sub>, 1<sub>2</sub> ..., 1<sub>n</sub>) and said host computer (2<sub>1</sub>, 2<sub>2</sub> ..., 2<sub>m</sub>); wherein

in each work station (1<sub>1</sub>, 1<sub>2</sub> ..., 1<sub>n</sub>), a processing request is issued and, a process corresponding thereto is executed in the own work station (1<sub>1</sub>, 1<sub>2</sub> ..., 1<sub>n</sub>) for a predetermined processing request; and

in each host computer (2<sub>1</sub>, 2<sub>2</sub> ..., 2<sub>m</sub>), in response to information for designating a particular processing process, said information being determined in said work station (1<sub>1</sub>, 1<sub>2</sub> ..., 1<sub>n</sub>) based on the processing request issued therein, a relevant one of individual processing processes which can be independently processed is designated and executed, whereby an on-line interactive processing is enabled between a request following process of said at least a work station (1<sub>1</sub>, 1<sub>2</sub> ..., 1<sub>n</sub>) and the designated individual process of said host computer (2<sub>1</sub>, 2<sub>2</sub> ..., 2<sub>m</sub>) through a communication path (3<sub>1</sub>, 3<sub>2</sub> ...) established under control of said control means (5, 6).

2. A distributed interactive processing method according to Claim 1 wherein

said work station (1<sub>1</sub>, 1<sub>2</sub> ..., 1<sub>n</sub>) includes a function to execute a server process (4<sub>1</sub>) of a relatively low level and

said host computer (2<sub>1</sub>, 2<sub>2</sub> ..., 2<sub>m</sub>) comprises a function to execute a server process (7<sub>1</sub>) of a relatively high level.

3. A distributed interactive processing method according to Claim 1 wherein said at least a work station (1<sub>1</sub>, 1<sub>2</sub> ..., 1<sub>n</sub>) includes a step responsive to an input of a processing request to analyze the processing request and determine an existence location where a program corresponding to the processing request exists (Fig. 5).

4. A distributed interactive processing method according to Claim 3 wherein

said request analyze step (Fig. 5) includes a substep to be executed when it is detected in said work station (1<sub>1</sub>, 1<sub>2</sub> ..., 1<sub>n</sub>) a condition that a particular server process (7<sub>1</sub>, 7<sub>2</sub> ..., 7<sub>l</sub>) of a particular one of said host computer (2<sub>1</sub>, 2<sub>2</sub> ..., 2<sub>m</sub>) is necessary for supplying said control means (5, 6) with a name of a processing objective process and

said control means (5, 6) connects the particular server process (7<sub>1</sub>, 7<sub>2</sub> ..., 7<sub>l</sub>) of said host computer to said work station (1<sub>1</sub>, 1<sub>2</sub> ..., 1<sub>n</sub>) in accordance with the name of the reception processing objective process, thereby allowing the processing request issued from a process of said work station to be received by the server process (7<sub>1</sub>, 7<sub>2</sub> ..., 7<sub>l</sub>).

5. A distributed interactive processing method according to Claim 4 wherein said server process (7<sub>1</sub>, 7<sub>2</sub> ..., 7<sub>l</sub>) includes processes (7<sub>b</sub>) each prepared to process a particular kind of request.

6. A distributed interactive processing method according to Claim 3 wherein said request analyzing step (Fig. 5) includes the following substeps of:

obtaining a process name with reference to a table (12) provided in said work station (1<sub>1</sub>, 1<sub>2</sub> ..., 1<sub>n</sub>), said table (12) including process names of processes (7<sub>1</sub>, 7<sub>2</sub> ..., 7<sub>l</sub>) each implementing a request to be inputted (61);

attaining a name of a processing objective by executing the obtained process (62); and

determining an existence location of the processing objective with reference to a directory (13, 63) provided in said at least work station.

7. A complex computer system including a plurality of work stations (IWS's), at least one host computer (HOST), communication lines (3<sub>1</sub>, 3<sub>2</sub> ...) connecting between the plurality of IWS's and said HOST, and communication control means (5, 6) for establishing and controlling communication paths (3<sub>1</sub>, 3<sub>2</sub> ...) between processes (4, 7) to conduct a communication between IWS's and said HOST each work station comprising therein:



input means (8-10) for receiving processing requests from the user;

a process name table (12) in which names of processes to respectively implement processings for various processing requests are registered;

means (11) responsive to the processing request from said input means (8-10) for determining a corresponding process name with reference to said process name table (12) and for initiating a process having the process name;

a directory (13) in which existence locations of processing objectives corresponding to names of processing objectives including a file name and a program name are beforehand registered;

process execution means (4<sub>1</sub>, 4<sub>2</sub> ..., 4<sub>n</sub>) for executing the initiated process,

said process execution means (4<sub>1</sub>, 4<sub>2</sub> ..., 4<sub>n</sub>) referencing said directory (13) to determine whether or not the existence location of the processing objectives is in the own IWS, executing the requested processing in the own IWS when the existence location is in the own IWS, and when the existence location is not in the own IWS, determining a server name of a HOST corresponding to the initiated process and issuing a connect request to the HOST; and

IWS communication control means (5) for receiving the connect request from said process execution means (4<sub>1</sub>, 4<sub>2</sub> ..., 4<sub>n</sub>) to connect to the server process and for connecting the IWS to said communication line (3<sub>1</sub>, 3<sub>2</sub> ...) and

said host computer comprising:

HOST communication control means (5, 6a) for controlling receiving and transferring of communication information from each said IWS, comprising;

a buffer existing in a virtual storage for storing information from said communication lines (3<sub>1</sub>, 3<sub>2</sub> ...), said store information including a process name of a source IWS issuing a request, a name of a server process as a communication destination in the HOST, and information indicating the content of the request from the IWS and

server process execution means (7<sub>1</sub>, 7<sub>2</sub> .....), responsive to indication information from said communication control means (6, 6a) of the HOST for executing the server process representing a process to implement a function for a particular operation objective.

8. A complex computer system according to Claim 7 wherein said HOST includes a name table (15) in which names of server processes and identifiers of spaces associated with the respective server processes are registered,

said server process execution means (7<sub>1</sub>, 7<sub>2</sub> ...) including a communication accept section (6a) for receiving information of a corresponding server space which is obtained by said HOST commu-

nication control means (6, 6a) by referencing said process name table (15) in response to the information from the IWS, and

said communication accept section (6a) establishing, when an acknowledge answer is to be issued, a connection between the process in the IWS and the server in the HOST, thereby enabling the server to effect an accept processing of the processing request from the particular process of the IWS.

FIG. 1

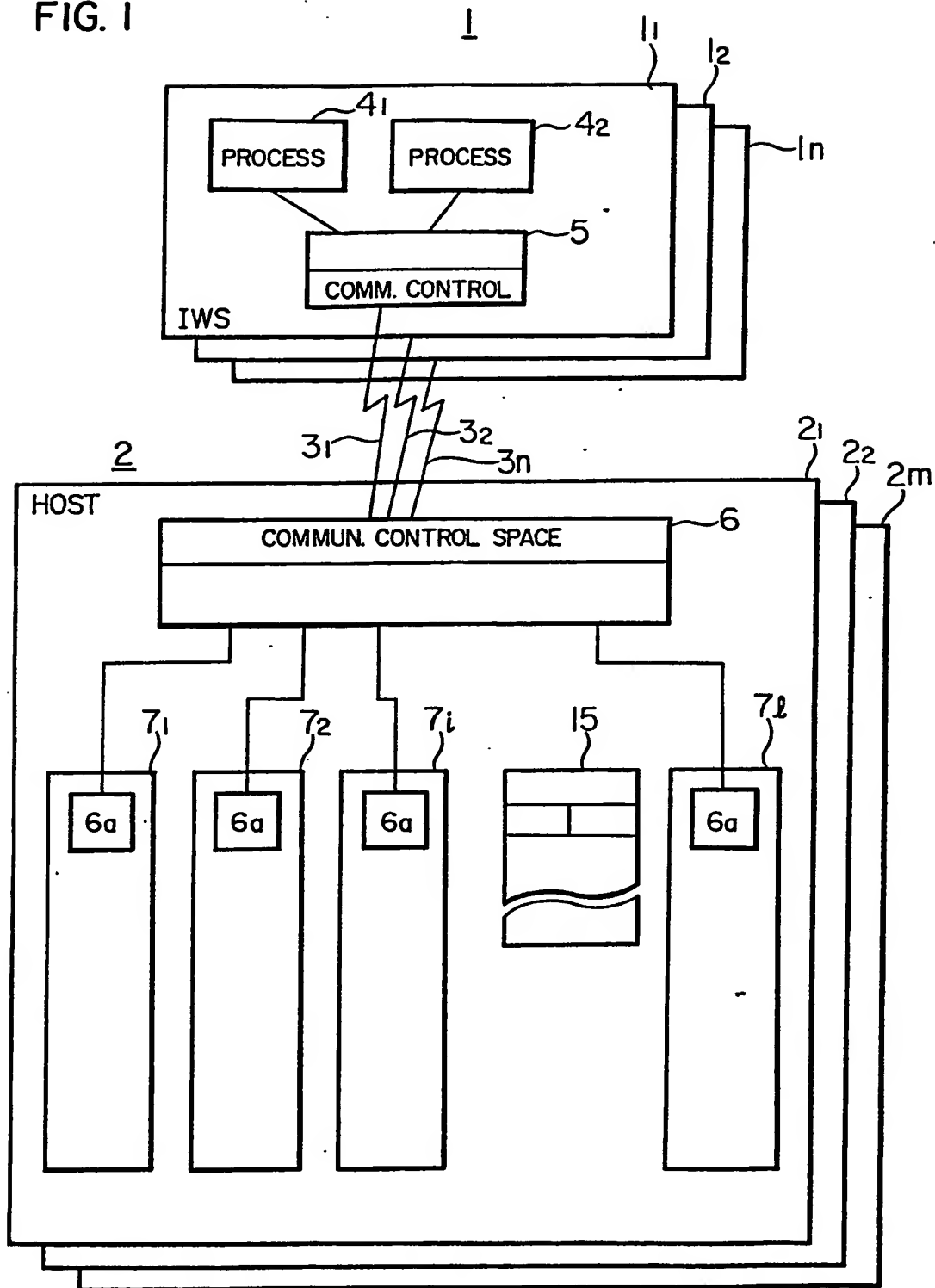


FIG. 2

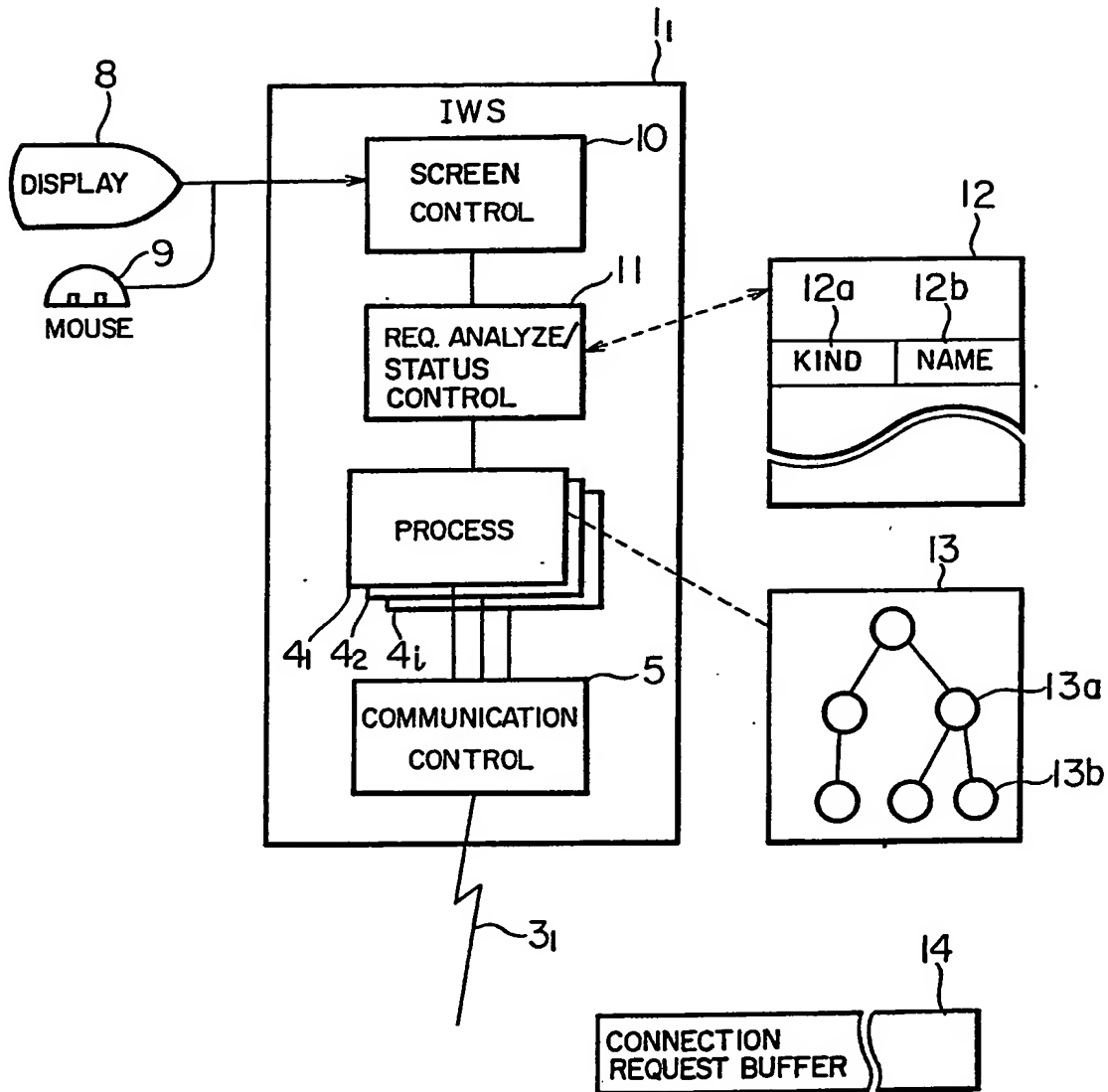


FIG. 3

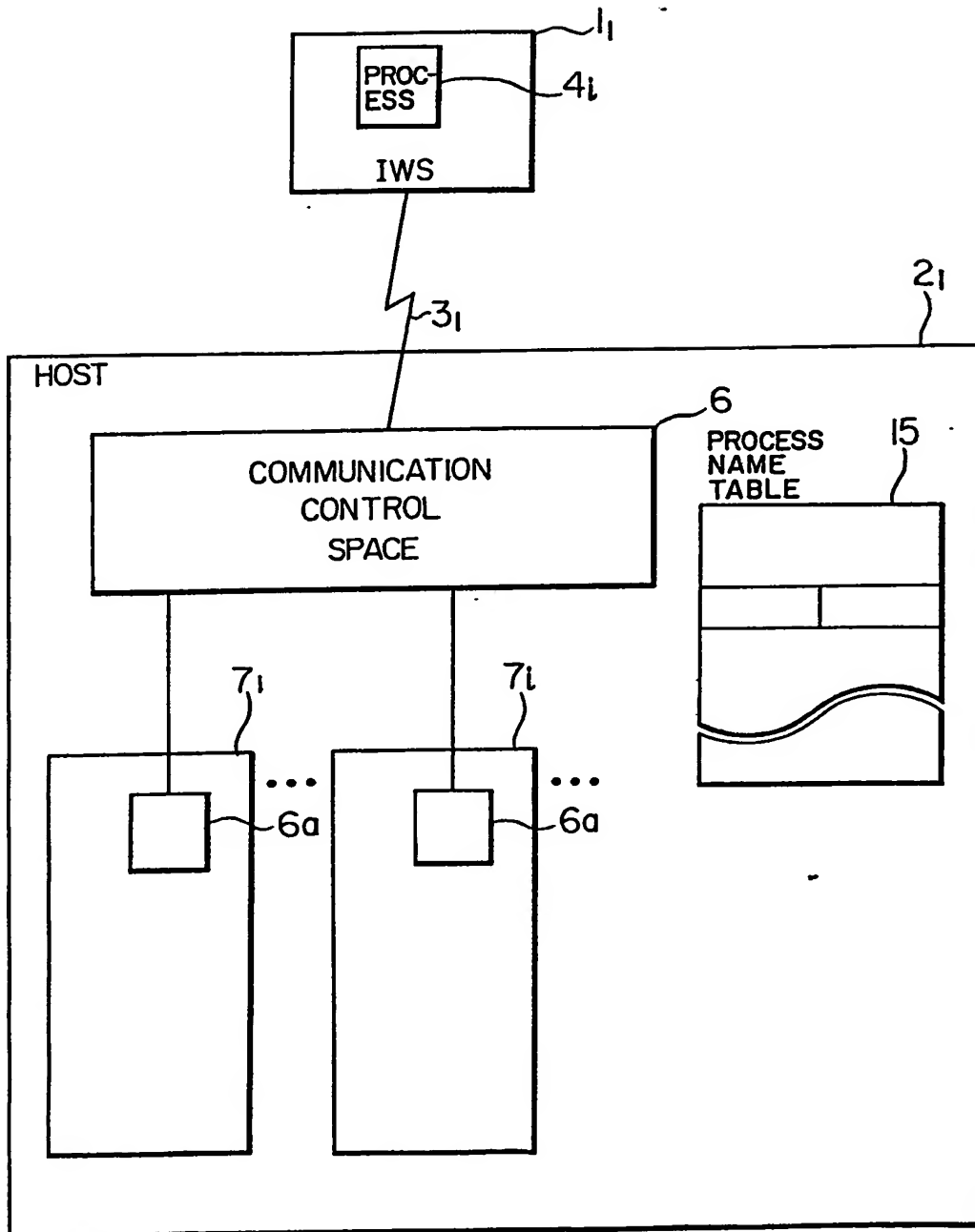


FIG. 4

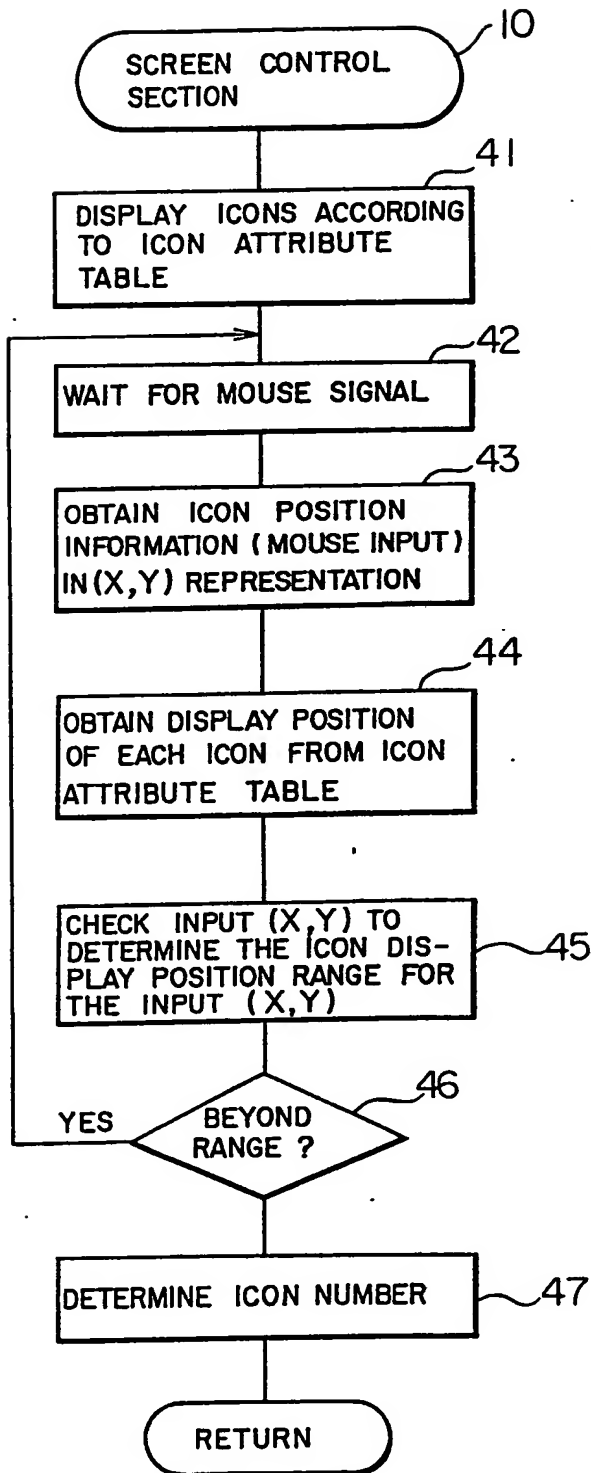


FIG. 5

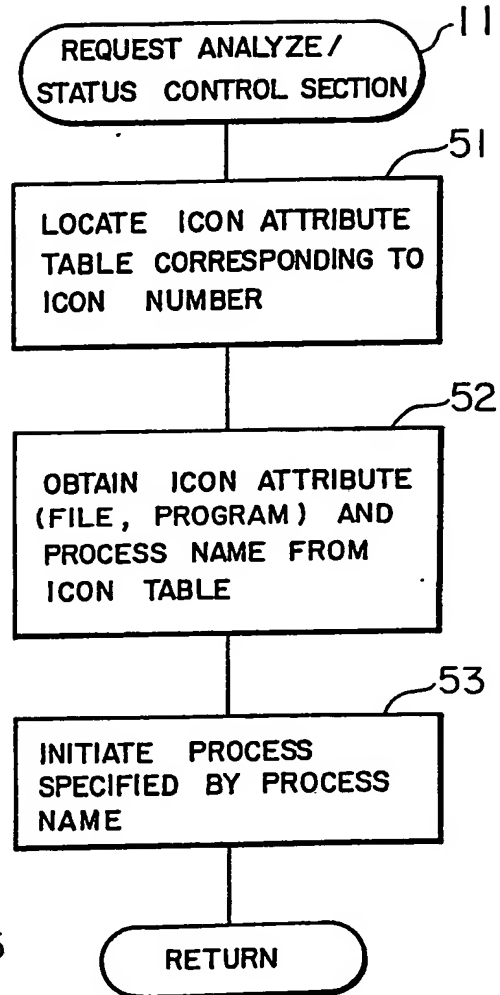


FIG. 6

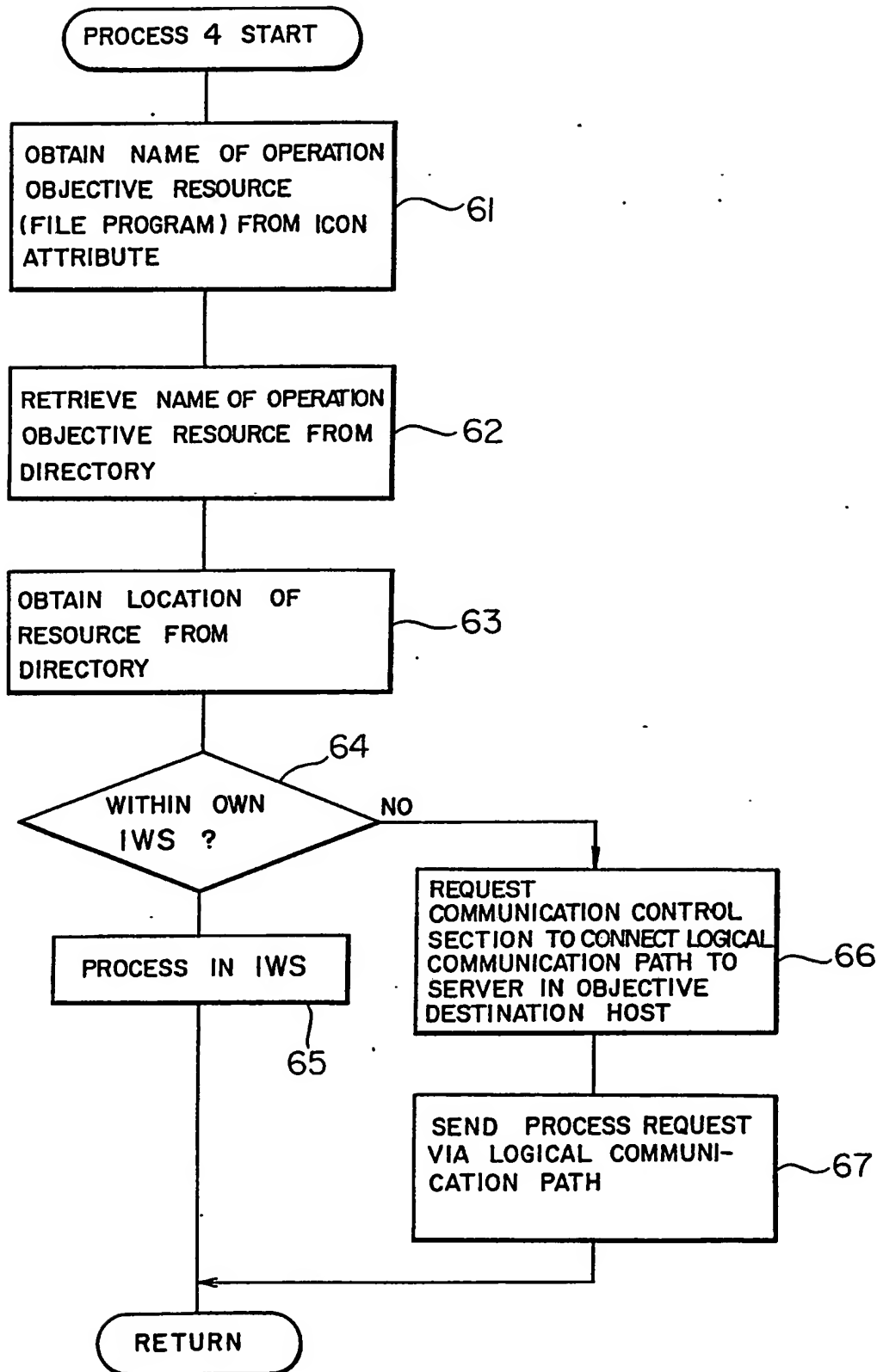


FIG. 7

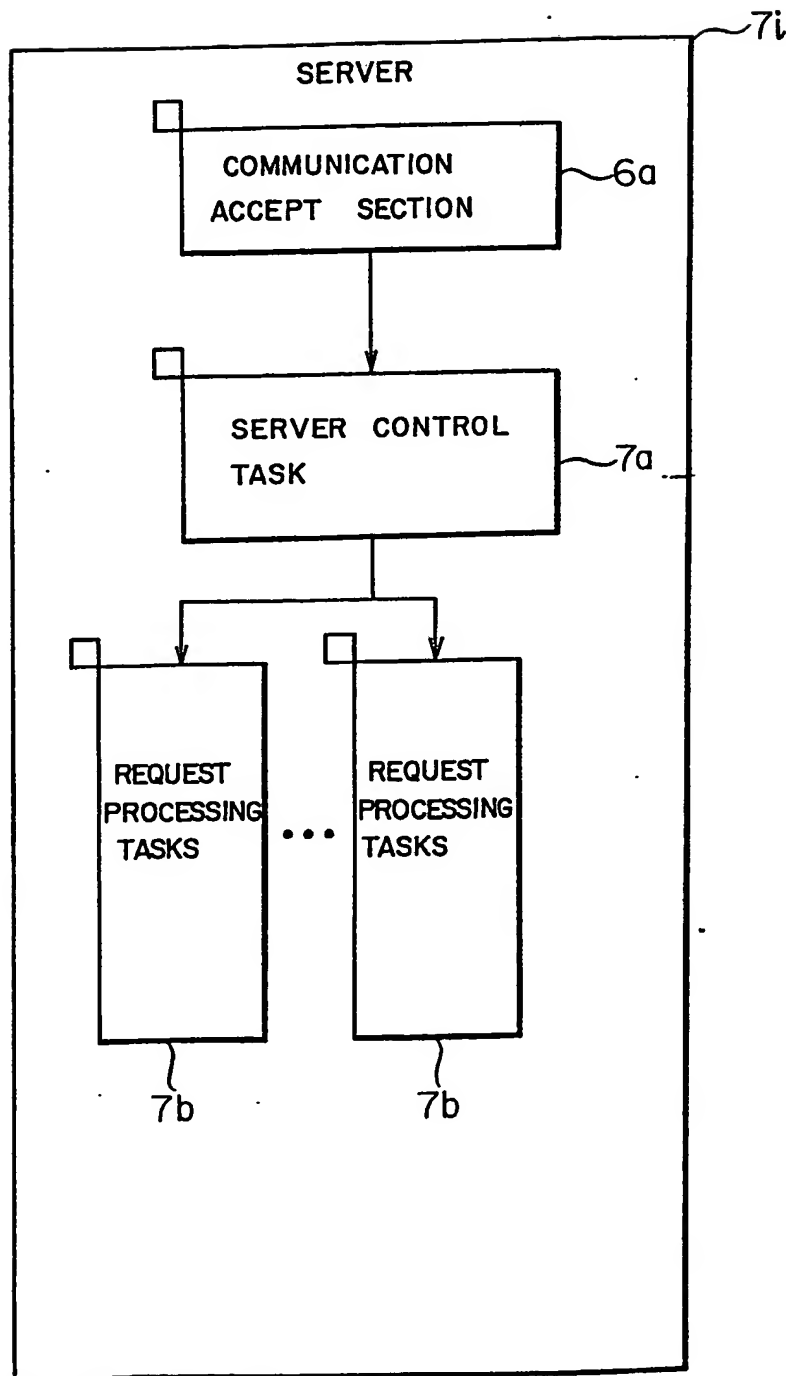




FIG. 8  
PRIOR ART  
ON-LINE TRANSACTION PROCESSING

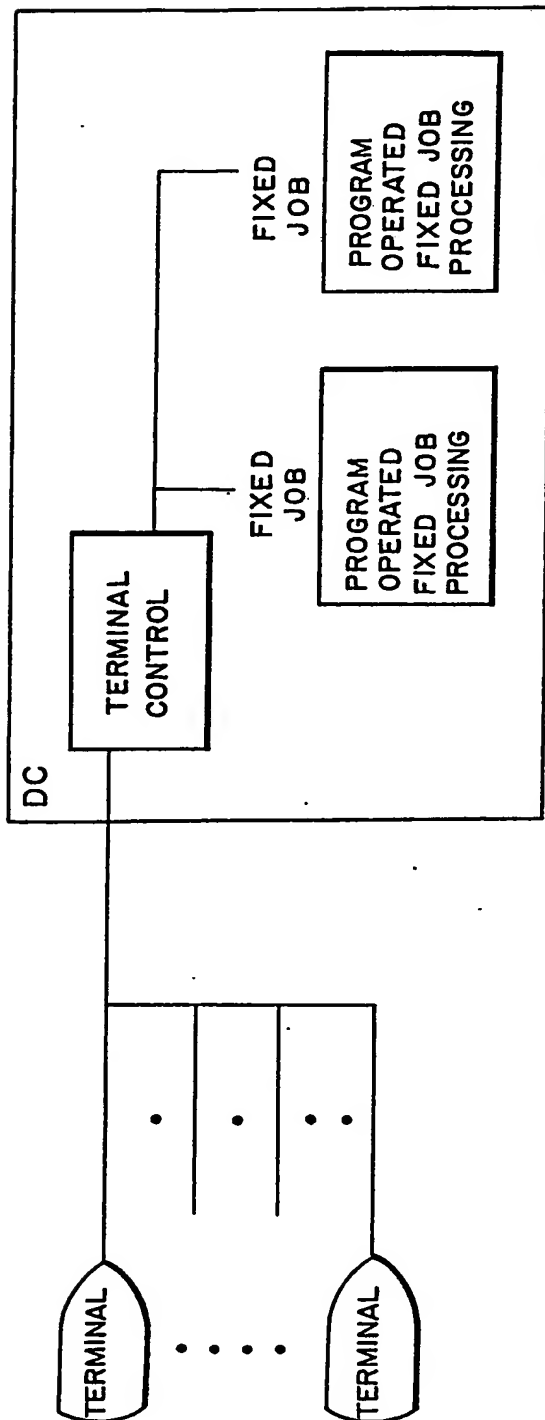


FIG. 9  
PRIOR ART

TSS

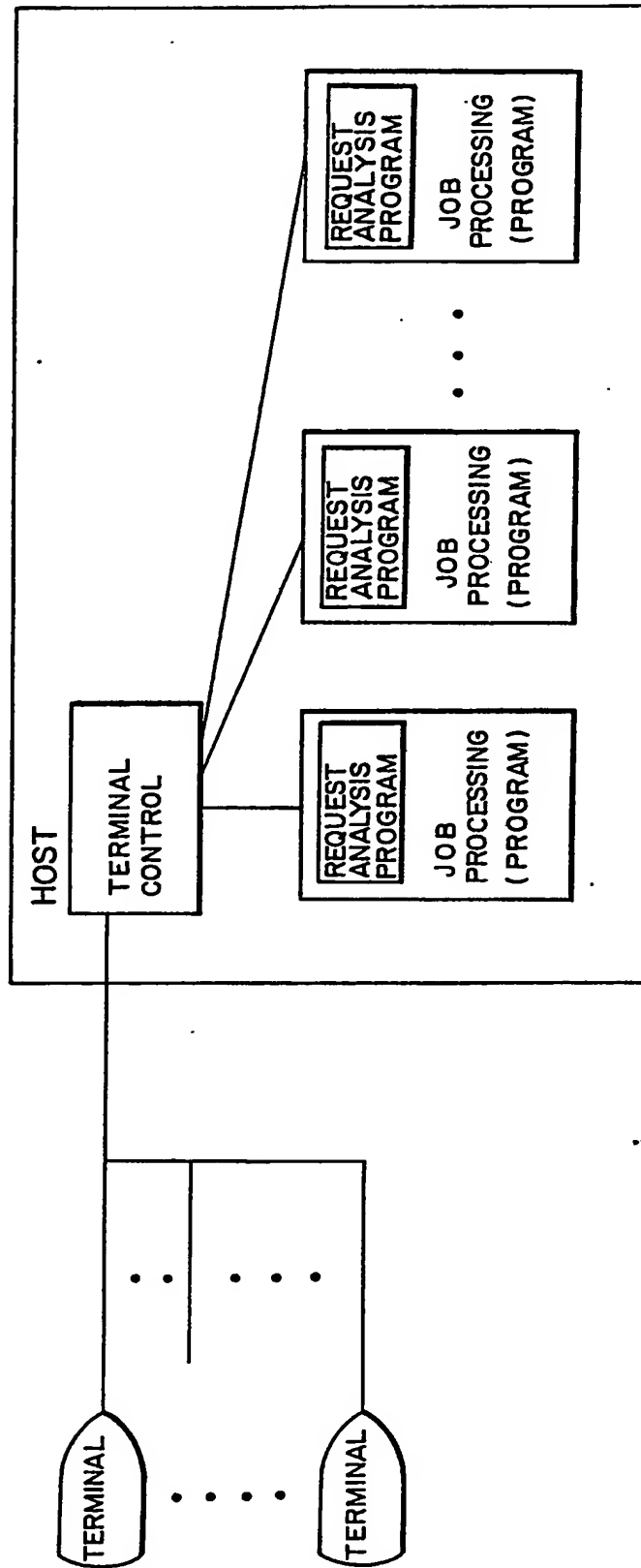
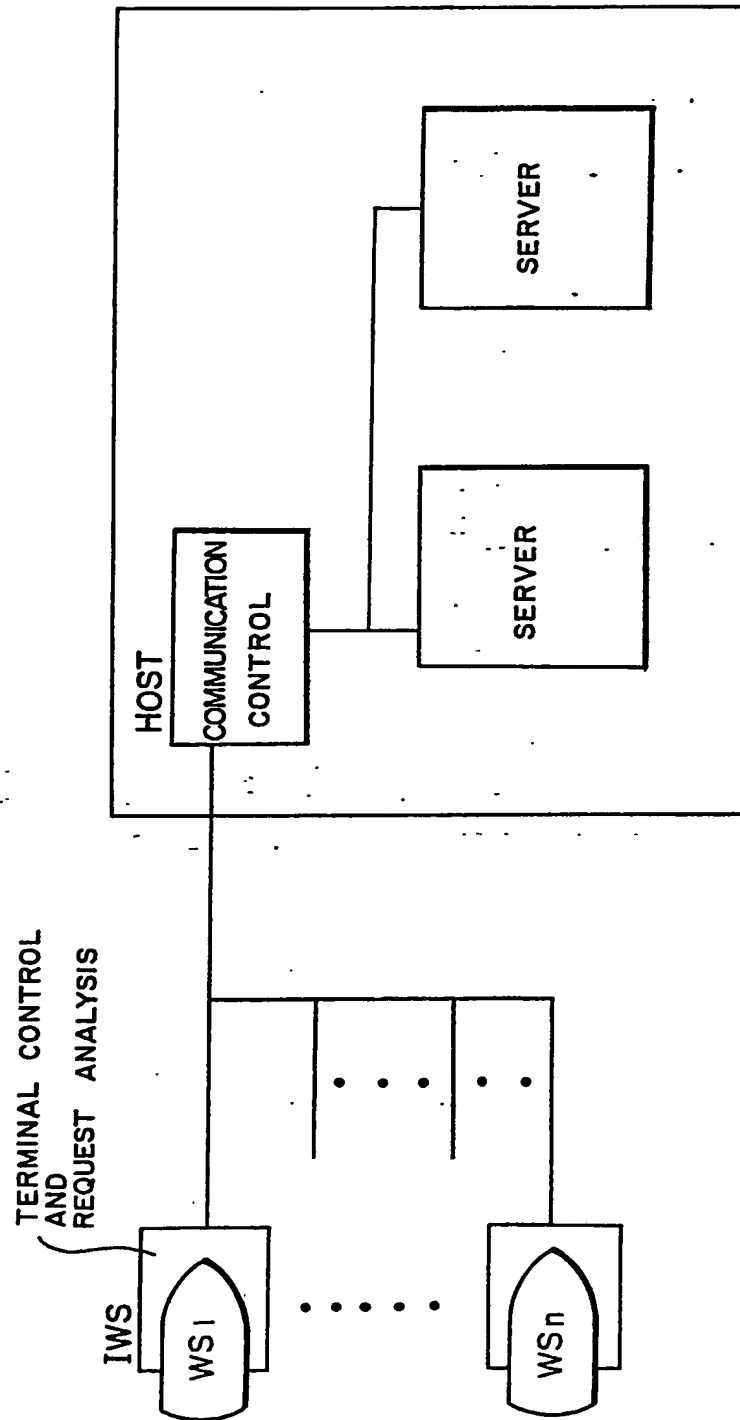


FIG. 10



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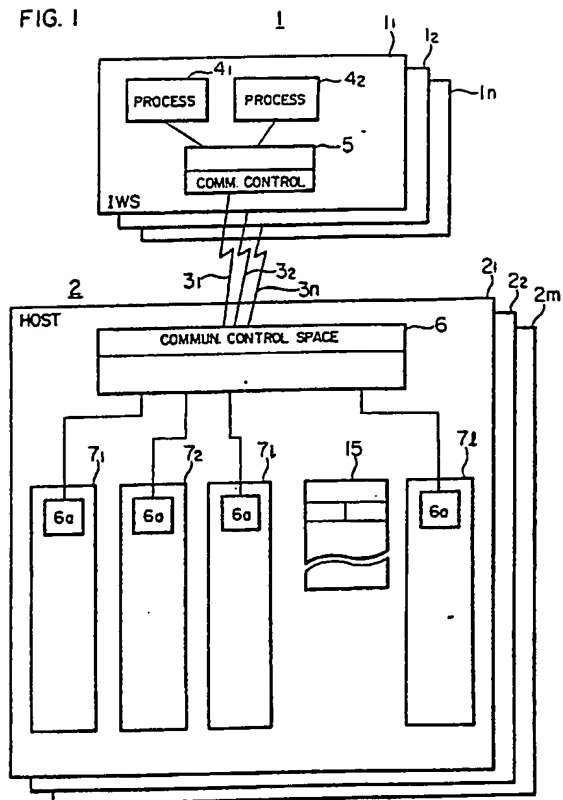
(54) Distributed interactive processing method in complex system including plural work stations and plural host computers and apparatus using the same.

EP 0 248 403 A3

(57) A distributed interactive processing in a complex computer system including a plurality of work stations (IWS's) (1<sub>1</sub>, 1<sub>2</sub>, ..., 1<sub>n</sub>) each having predetermined server processes, at least one host computer (HOST) (2<sub>1</sub>, 2<sub>2</sub>, ..., 2<sub>m</sub>), communication lines (3<sub>1</sub>, 3<sub>2</sub>, ...) interconnecting between the plurality of IWS's and the HOSTs, and communication control portions (5, 6) to establish and to control communication paths (3<sub>1</sub>, 3<sub>2</sub>, ...) between processes (4, 7) to conduct a process-to-process communication between the IWS's (1<sub>1</sub>, 1<sub>2</sub>, ..., 1<sub>n</sub>) and the HOSTs (2<sub>1</sub>, 2<sub>2</sub>, ..., 2<sub>m</sub>). Each IWS has therein a process (4<sub>1</sub>, 4<sub>2</sub>, ..., 4<sub>i</sub>) to implement an assigned processing request and a request control section (11) to analyze the processing request issued by the own IWS (1<sub>1</sub>, 1<sub>2</sub>, ..., 1<sub>n</sub>) and to determine a server process (7<sub>1</sub>, 7<sub>2</sub>, ..., 7<sub>l</sub>) required to implement the processing request. Among a re-

sult of the request analysis, a predetermined server process is executed in the own IWS. The communication control portions (5, 6) establish a communication path (3<sub>1</sub>, 3<sub>2</sub>, ...) between an associated server process (7<sub>l</sub>) in the relevant HOST (2<sub>1</sub>, 2<sub>2</sub>, ..., 2<sub>m</sub>) and the request process (4) in the IWS in accordance with the determination in the IWS regarding server process and thereby enable the IWS (1<sub>1</sub>, 1<sub>2</sub>, ..., 1<sub>n</sub>) to perform an on-line interactive processing in combination of the server process (7<sub>l</sub>) in the HOST (2<sub>1</sub>, 2<sub>2</sub>, ..., 2<sub>m</sub>) and the process (4<sub>i</sub>) in the IWS (1<sub>1</sub>, 1<sub>2</sub>, ..., 1<sub>n</sub>).

FIG. 1





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## EUROPEAN SEARCH REPORT

Application Number

EP 87 10 7964

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	PROCEEDINGS 1st INTERNATIONAL CONFERENCE ON COMPUTER WORKSTATIONS, San Jose, California, 11th-14th November 1985, pages 198-208, IEEE, New York, US; R. AGRAWAL et al.: "Processor sharing in nest: A network of computer workstations" * Page 199, column 1, lines 1-44; column 2, lines 1-11; page 201, column 2, lines 1-50, 1-2; page 202, column 2, lines 28-33; page 204, column 2; figure 3 *	1-8	G 06 F 9/46 G 06 F 15/16
X	PROCEEDINGS OF THE 1985 INTERNATIONAL CONFERENCE ON PARALLEL PROCESSING, 20th-23rd August 1985, pages 139-142, IEEE, New York, US; A.K. EZZAT et al.: "Making oneself known in a distributed world" * Whole article *	1-8	
A	EP-A-0 108 899 (IBM) * Page 4, lines 1-30; page 5, lines 1-12 *	2, 3, 5	TECHNICAL FIELDS SEARCHED (Int. Cl.4) G 06 F 9/46 G 06 F 15/16
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 31-10-1989	Examiner DHEERE R.F.B.M.
<b>CATEGORY OF CITED DOCUMENTS</b> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			